110
159
116
117
131
132
133
132
118
115
113
ABC
1234
0000000
108
100
144
109
114
CONCIERGE SERVICE
LOCAL NODE
106
102
SERVER
REGIONAL NODE
104
144
108
112
INTERNET
LOCAL NODE:
*KIOSK
*CELL SITE
*LAN
*TELCO
*CABLE
*SATELLITE
*SERVER
*OTHER
106

FIG. 1

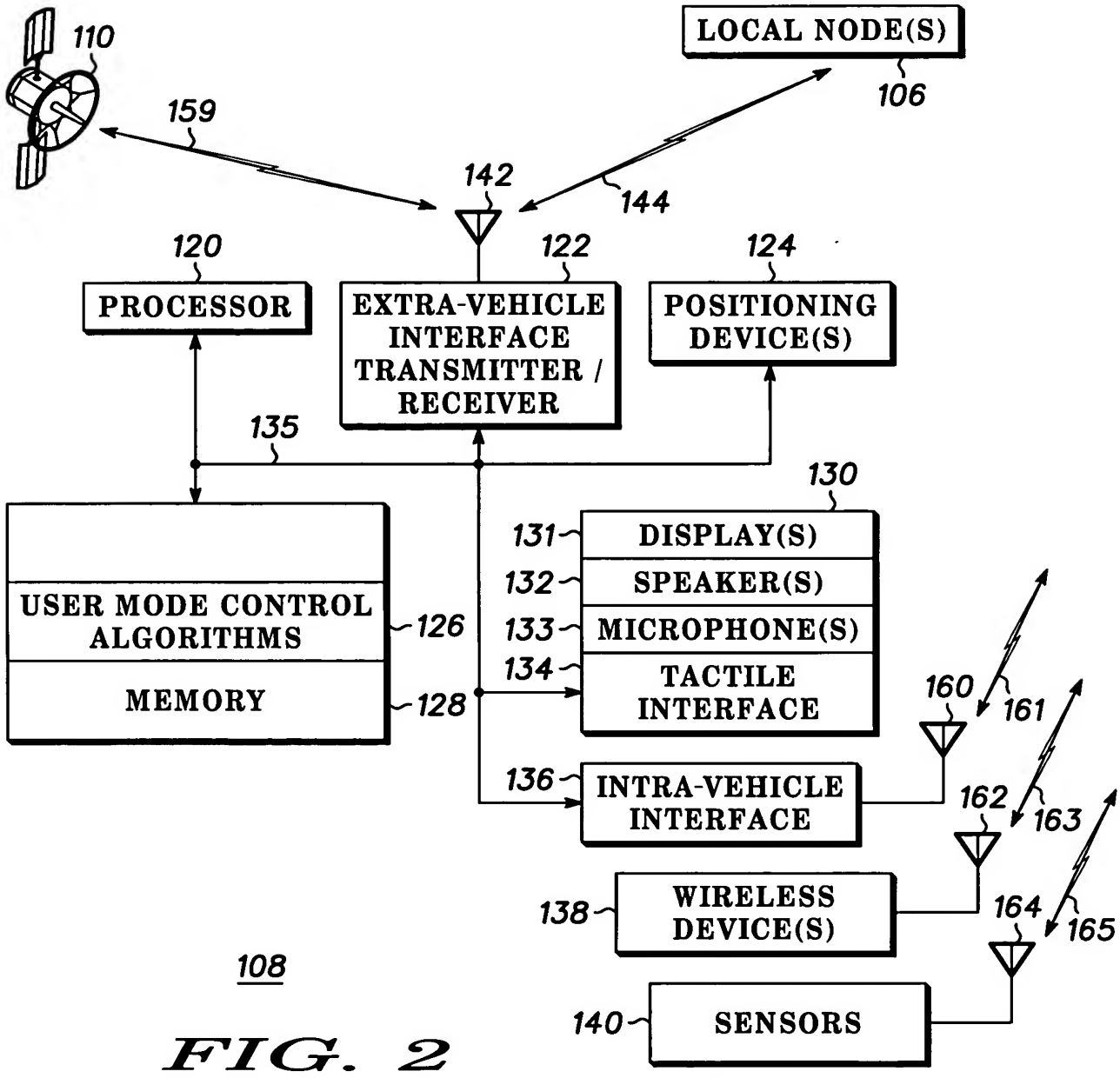
110
LOCAL NODE(S)
106
159
142
144
120
122
124
PROCESSOR
EXTRA-VEHICLE INTERFACE TRANSMITTER / RECEIVER
POSITIONING DEVICE(S)
135
130
USER MODE CONTROL ALGORITHMS
126
MEMORY
128
131
DISPLAY(S)
132
SPEAKER(S)
133
MICROPHONE(S)
134
TACTILE INTERFACE
160
161
136
INTRA-VEHICLE INTERFACE
162
163
138
WIRELESS DEVICE(S)
164
165
140
SENSORS
108

FIG. 2

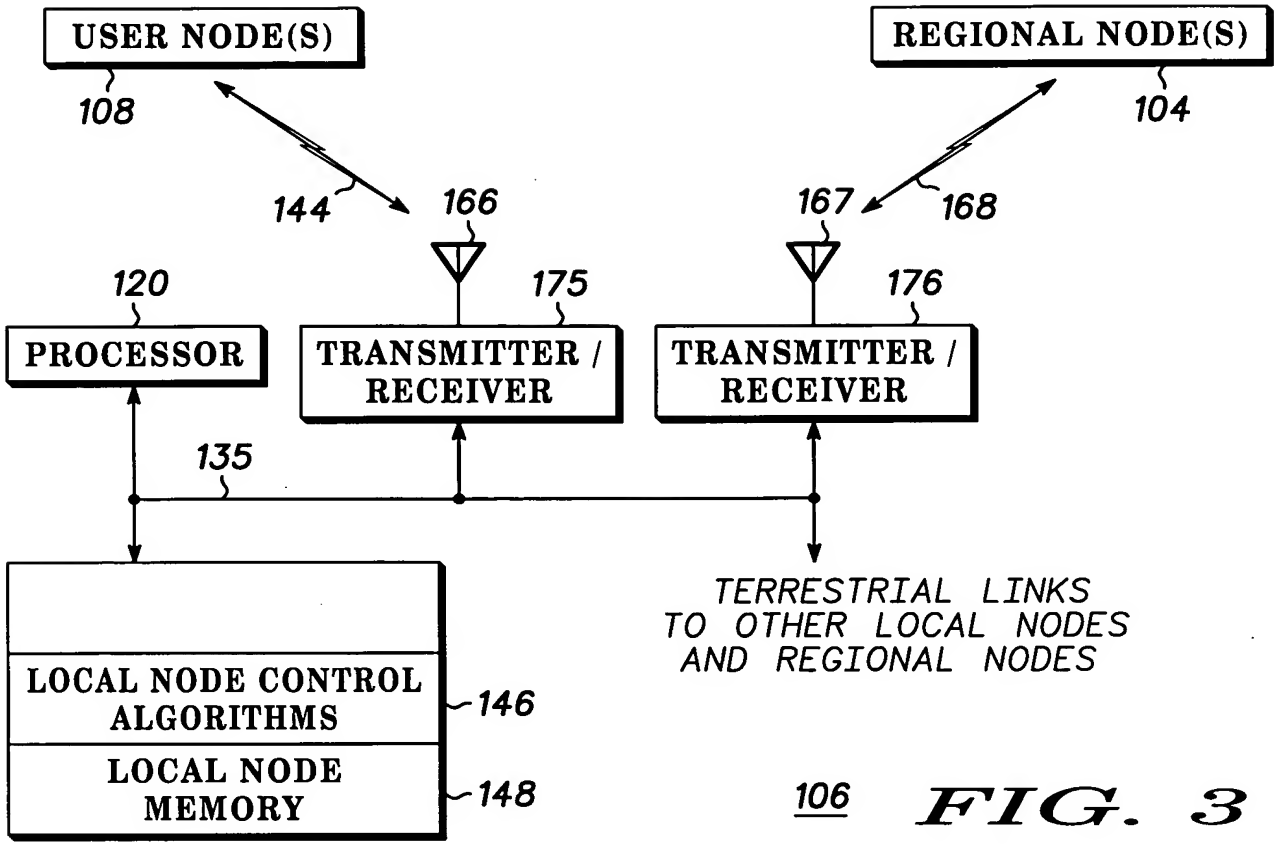
USER NODE(S)
108
REGIONAL NODE(S)
104
144
166
167
168
120
175
176
PROCESSOR
TRANSMITTER / RECEIVER
TRANSMITTER / RECEIVER
135
LOCAL NODE CONTROL ALGORITHMS
146
LOCAL NODE MEMORY
148
TERRESTRIAL LINKS TO OTHER LOCAL NODES AND REGIONAL NODES
106

FIG. 3

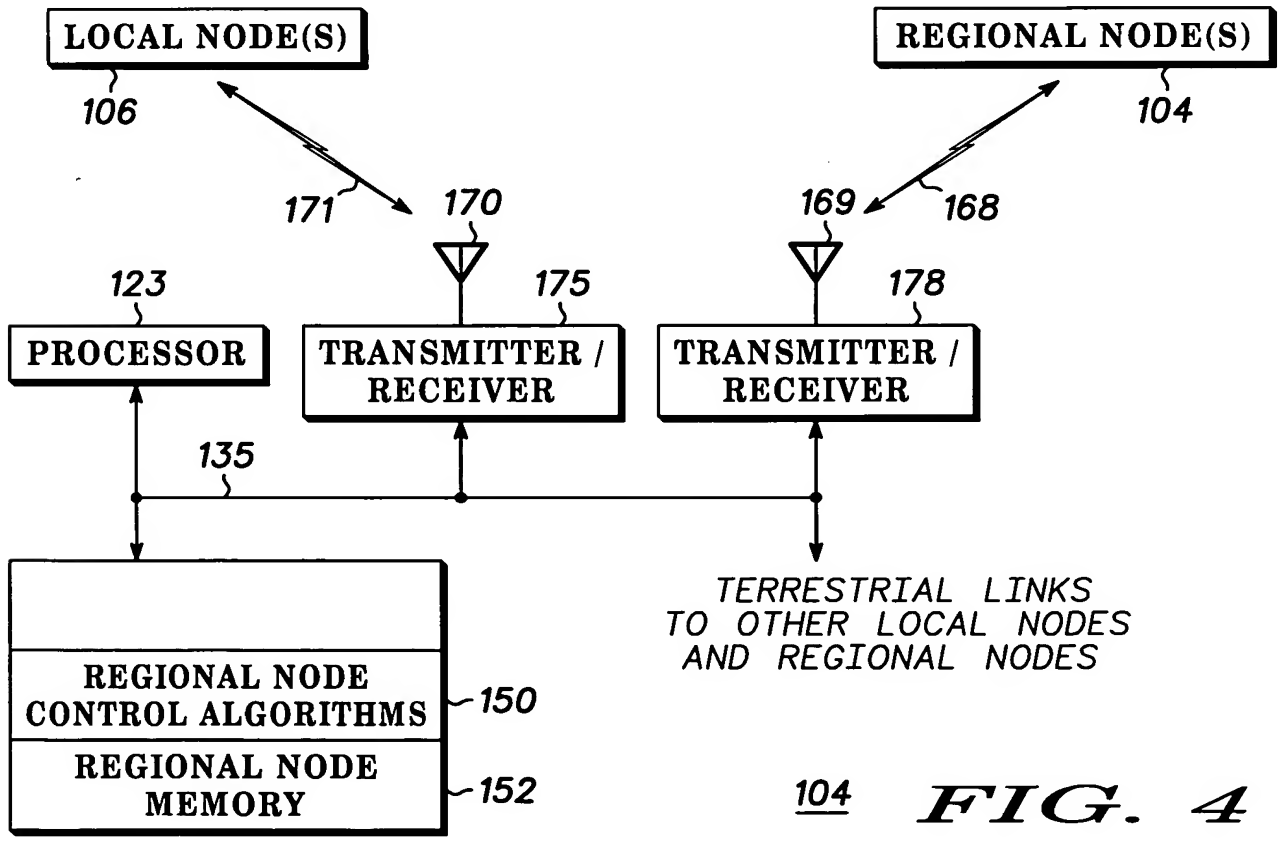
LOCAL NODE(S)
106
REGIONAL NODE(S)
104
171
170
169
168
123
175
178
PROCESSOR
TRANSMITTER / RECEIVER
TRANSMITTER / RECEIVER
135
REGIONAL NODE CONTROL ALGORITHMS
150
REGIONAL NODE MEMORY
152
TERRESTRIAL LINKS TO OTHER LOCAL NODES AND REGIONAL NODES
104

FIG. 4

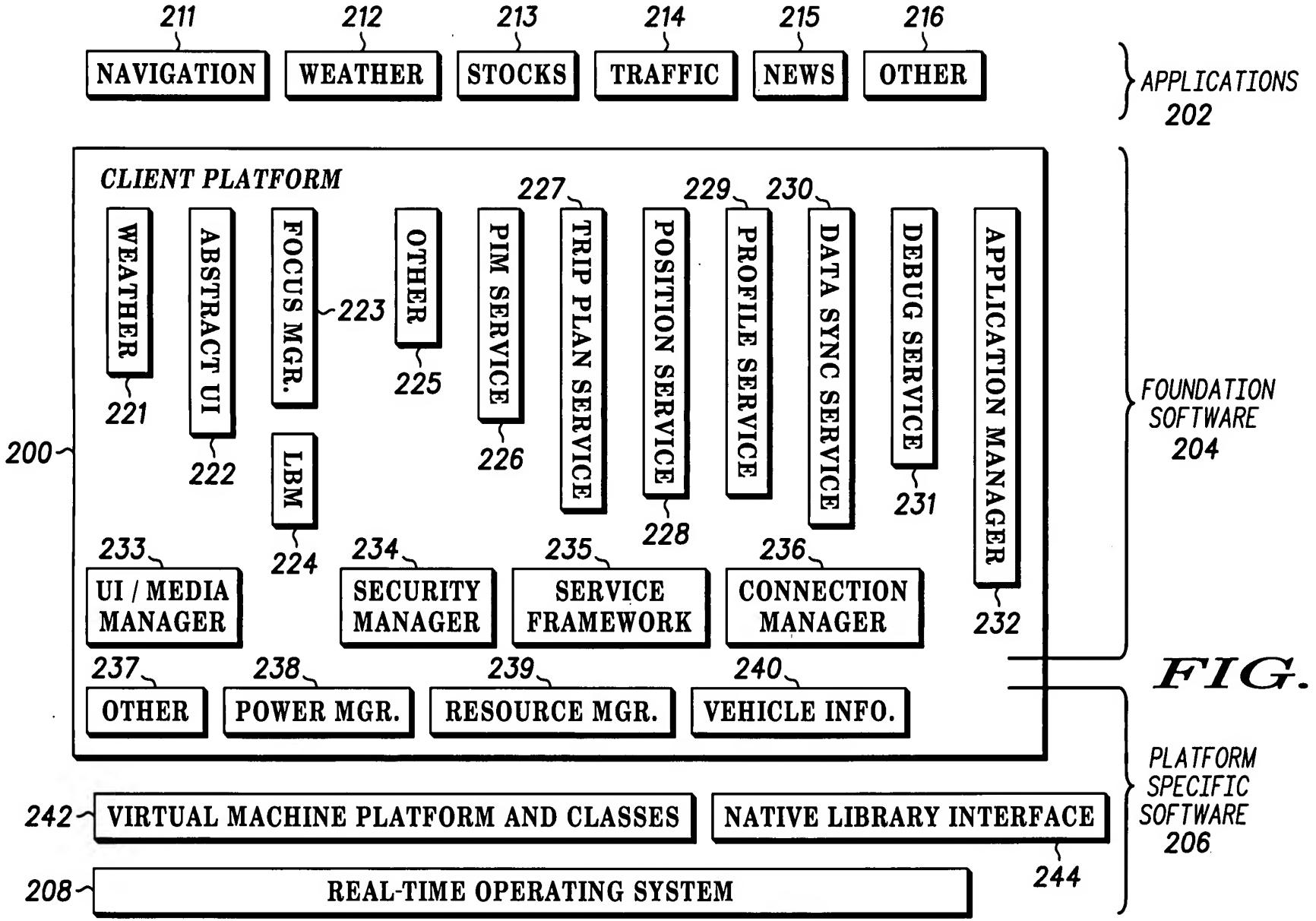
211
NAVIGATION
212
WEATHER
213
STOCKS
214
TRAFFIC
215
NEWS
216
OTHER
APPLICATIONS
202
CLIENT PLATFORM
200
WEATHER
221
ABSTRACT UI
222
FOCUS MGR.
223
LBM
224
OTHER
225
PIM SERVICE
226
227
TRIP PLAN SERVICE
POSITION SERVICE
228
229
PROFILE SERVICE
230
DATA SYNC SERVICE
DEBUG SERVICE
231
APPLICATION MANAGER
232
FOUNDATION SOFTWARE
204
233
UI / MEDIA MANAGER
234
SECURITY MANAGER
235
SERVICE FRAMEWORK
236
CONNECTION MANAGER
237
OTHER
238
POWER MGR.
239
RESOURCE MGR.
240
VEHICLE INFO.
242
VIRTUAL MACHINE PLATFORM AND CLASSES
NATIVE LIBRARY INTERFACE
244
208
REAL-TIME OPERATING SYSTEM
PLATFORM SPECIFIC SOFTWARE
206

FIG. 5

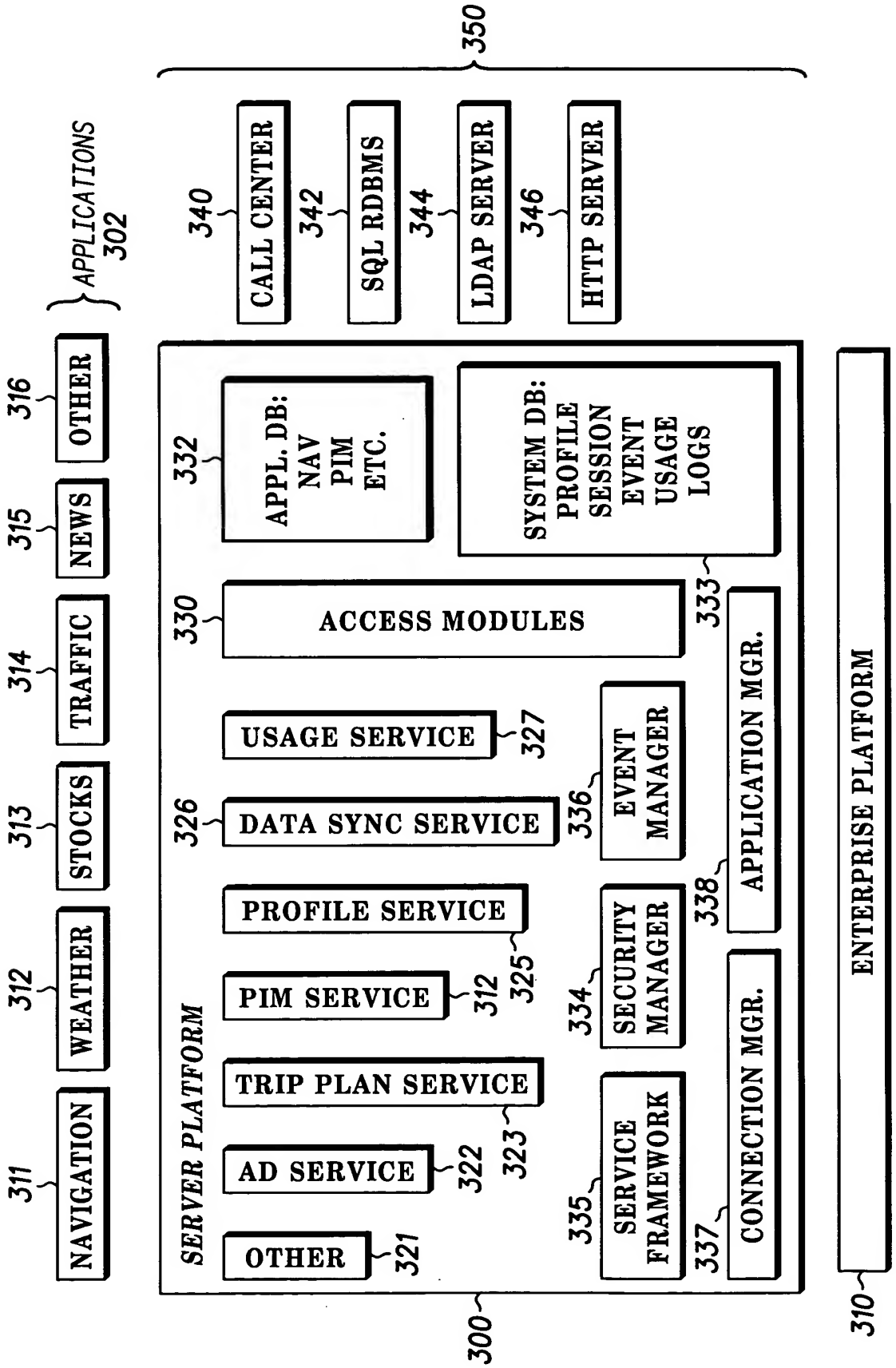
APPLICATIONS
302
311
NAVIGATION
312
WEATHER
313
STOCKS
314
TRAFFIC
315
NEWS
316
OTHER
350
340
CALL CENTER
342
SQL RDBMS
344
LDAP SERVER
346
HTTP SERVER
SERVER PLATFORM
OTHER
321
AD SERVICE
322
TRIP PLAN SERVICE
323
PIM SERVICE
312
325
PROFILE SERVICE
326
DATA SYNC SERVICE
USAGE SERVICE
327
330
ACCESS MODULES
332
APPL. DB:
NAV
PIM
ETC.
SYSTEM DB:
PROFILE
SESSION
EVENT
USAGE
LOGS
333
335
SERVICE FRAMEWORK
334
SECURITY MANAGER
336
EVENT MANAGER
337
CONNECTION MGR.
338
APPLICATION MGR.
300
ENTERPRISE PLATFORM
310

FIG. 6

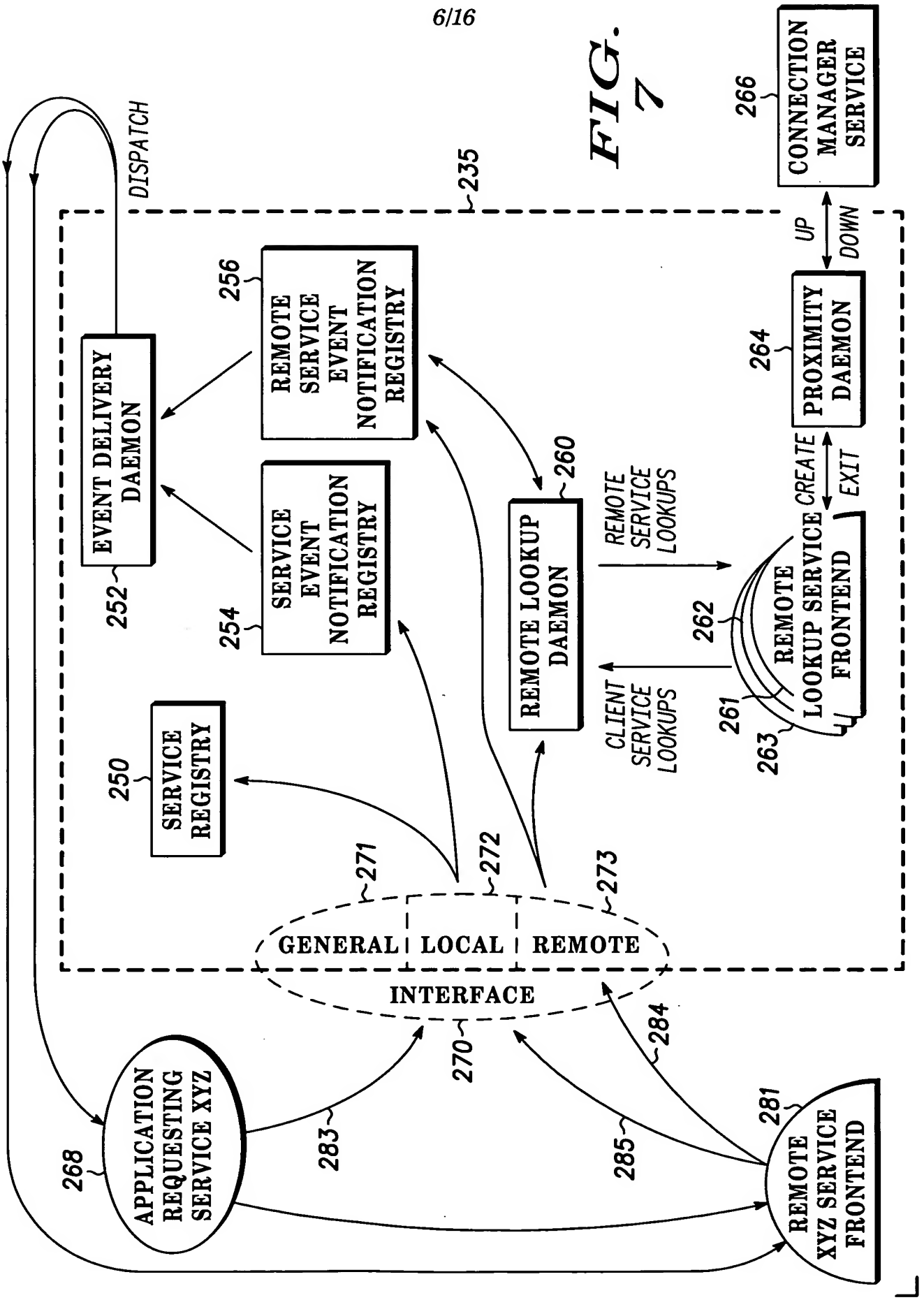
DISPATCH
235
266
CONNECTION MANAGER SERVICE
UP
DOWN
256
REMOTE SERVICE EVENT NOTIFICATION REGISTRY
264
PROXIMITY DAEMON
EVENT DELIVERY DAEMON
252
254
SERVICE EVENT NOTIFICATION REGISTRY
260
REMOTE LOOKUP DAEMON
REMOTE SERVICE LOOKUPS
CREATE
EXIT
262
REMOTE LOOKUP SERVICE FRONTEND
CLIENT SERVICE LOOKUPS
261
263
250
SERVICE REGISTRY
271
272
273
GENERAL
LOCAL
REMOTE
INTERFACE
270
284
268
APPLICATION REQUESTING SERVICE XYZ
283
285
281
REMOTE XYZ SERVICE FRONTEND

FIG. 7

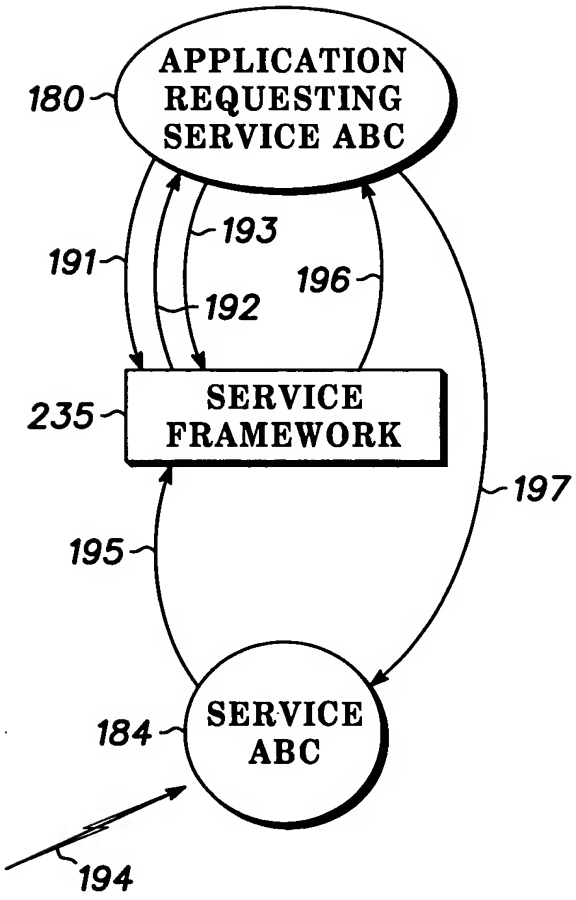
APPLICATION REQUESTING SERVICE ABC
180
193
191
196
192
SERVICE FRAMEWORK
235
197
195
SERVICE ABC
184
194

FIG. 8

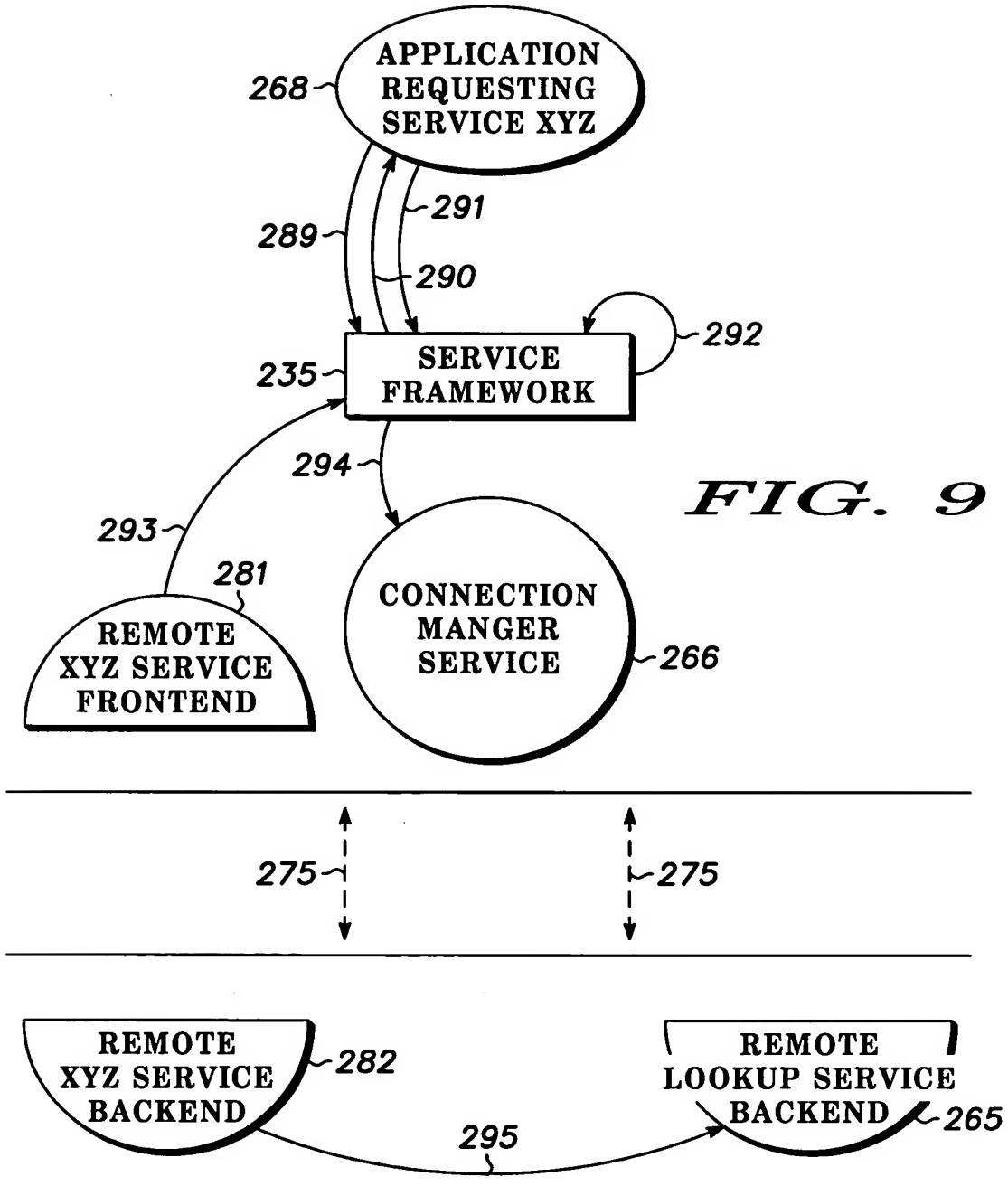
APPLICATION REQUESTING SERVICE XYZ
268
289
291
290
292
SERVICE FRAMEWORK
235
294
293
281
REMOTE XYZ SERVICE FRONTEND
CONNECTION MANGER SERVICE
266
275
275
REMOTE XYZ SERVICE BACKEND
282
295
REMOTE LOOKUP SERVICE BACKEND
265

FIG. 9

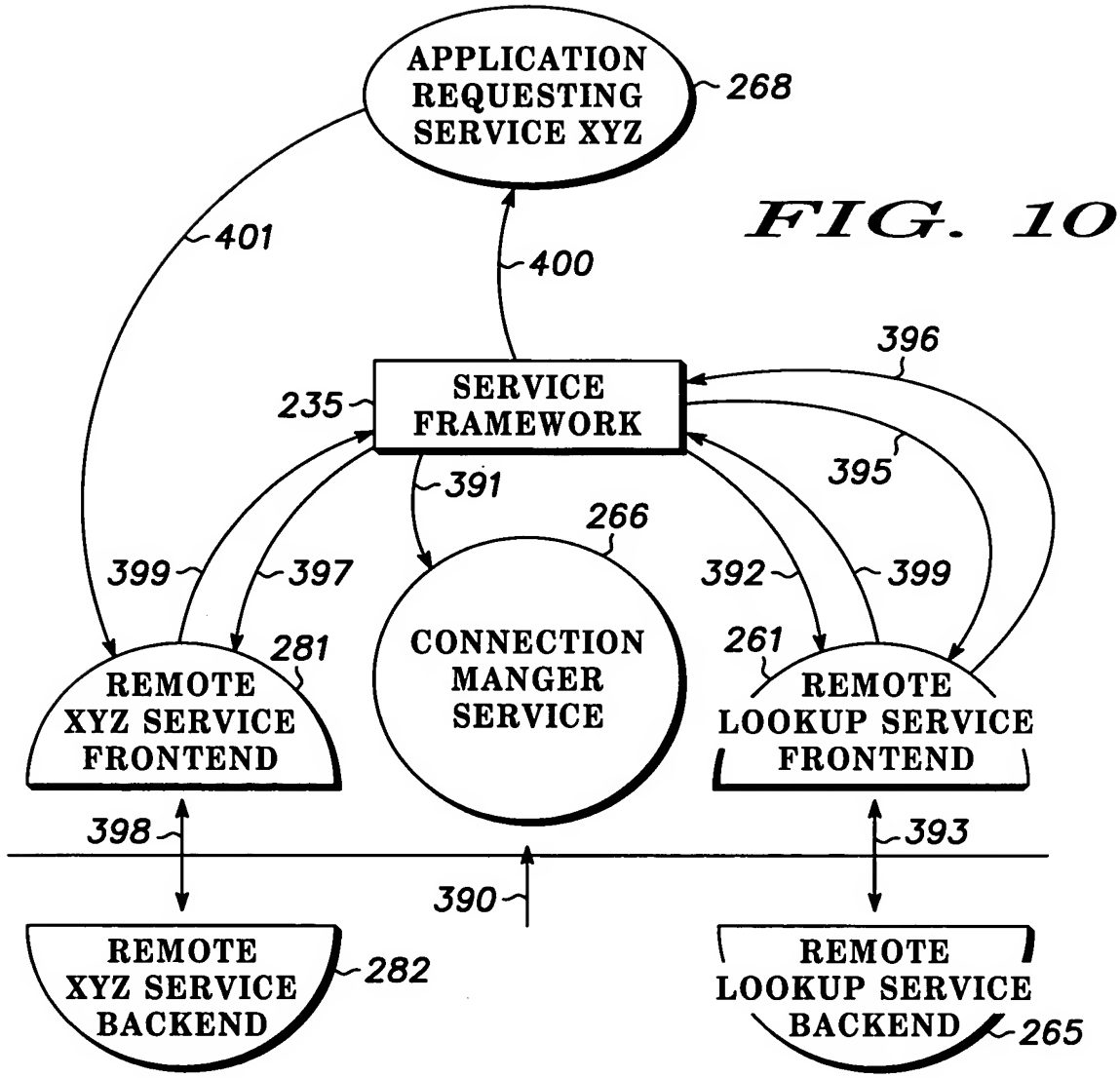
APPLICATION REQUESTING SERVICE XYZ
268
401
400
396
235
SERVICE FRAMEWORK
395
391
266
399
397
392
399
281
CONNECTION MANGER SERVICE
261
REMOTE XYZ SERVICE FRONTEND
REMOTE LOOKUP SERVICE FRONTEND
398
393
390
REMOTE XYZ SERVICE BACKEND
282
REMOTE LOOKUP SERVICE BACKEND
265

FIG. 10

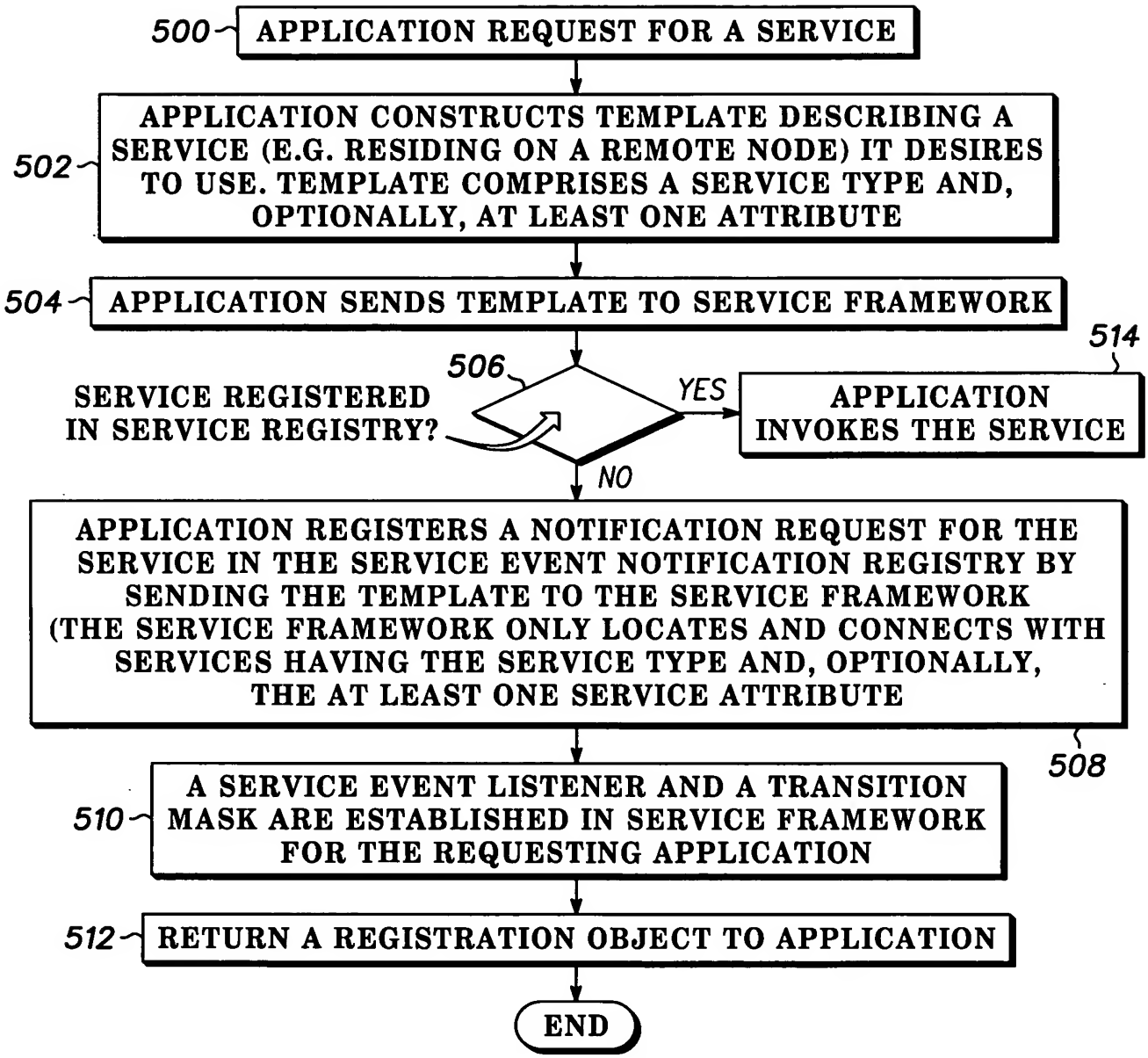
500
APPLICATION REQUEST FOR A SERVICE
502
APPLICATION CONSTRUCTS TEMPLATE DESCRIBING A SERVICE (E.G. RESIDING ON A REMOTE NODE) IT DESIRES TO USE. TEMPLATE COMPRISES A SERVICE TYPE AND, OPTIONALLY, AT LEAST ONE ATTRIBUTE
504
APPLICATION SENDS TEMPLATE TO SERVICE FRAMEWORK
506
SERVICE REGISTERED IN SERVICE REGISTRY?
YES
514
APPLICATION INVOKES THE SERVICE
NO
APPLICATION REGISTERS A NOTIFICATION REQUEST FOR THE SERVICE IN THE SERVICE EVENT NOTIFICATION REGISTRY BY SENDING THE TEMPLATE TO THE SERVICE FRAMEWORK (THE SERVICE FRAMEWORK ONLY LOCATES AND CONNECTS WITH SERVICES HAVING THE SERVICE TYPE AND, OPTIONALLY, THE AT LEAST ONE SERVICE ATTRIBUTE
508
510
A SERVICE EVENT LISTENER AND A TRANSITION MASK ARE ESTABLISHED IN SERVICE FRAMEWORK FOR THE REQUESTING APPLICATION
512
RETURN A REGISTRATION OBJECT TO APPLICATION
END

FIG. 11

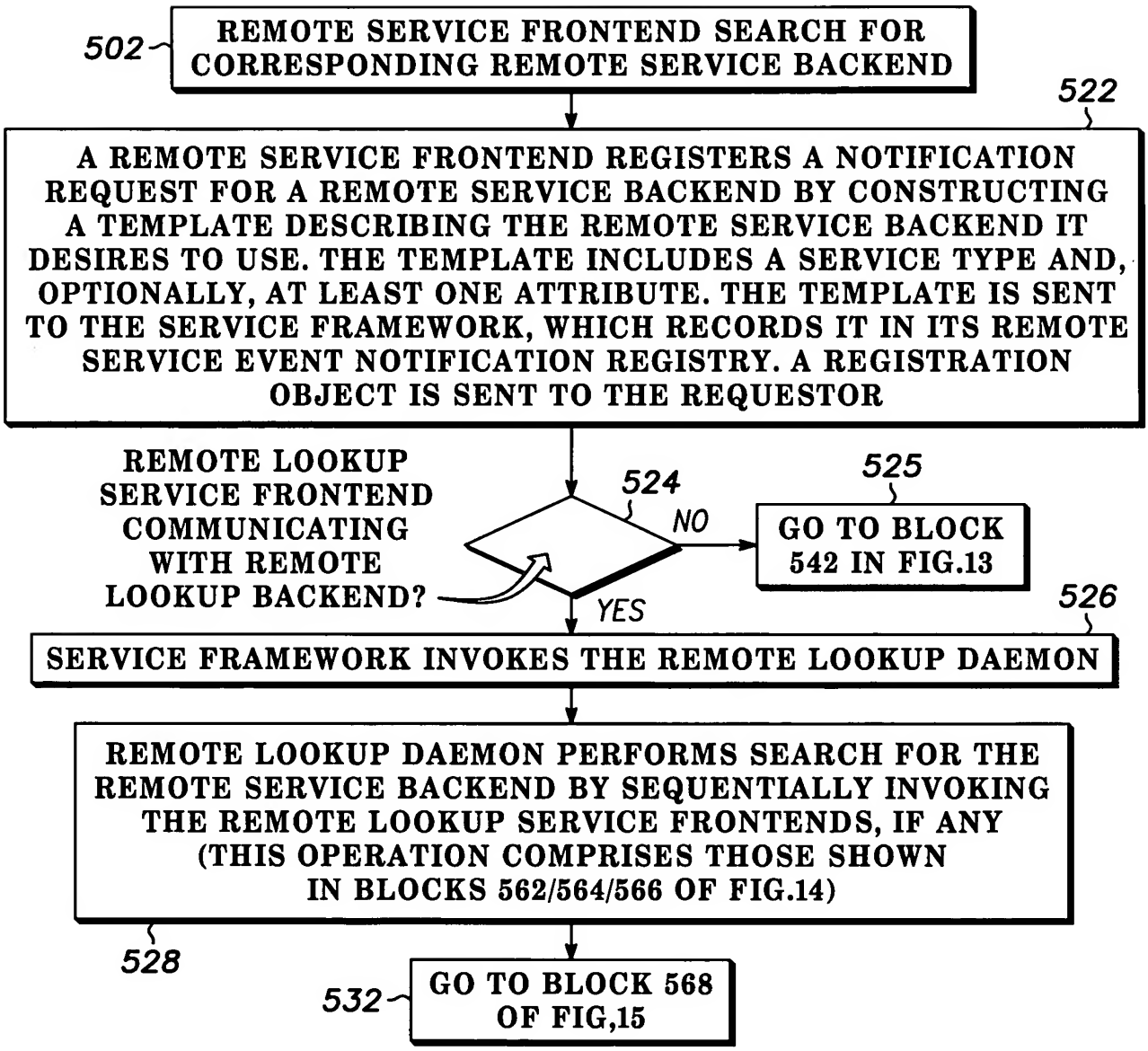
502
REMOTE SERVICE FRONTEND SEARCH FOR CORRESPONDING REMOTE SERVICE BACKEND
522
A REMOTE SERVICE FRONTEND REGISTERS A NOTIFICATION REQUEST FOR A REMOTE SERVICE BACKEND BY CONSTRUCTING A TEMPLATE DESCRIBING THE REMOTE SERVICE BACKEND IT DESIRES TO USE. THE TEMPLATE INCLUDES A SERVICE TYPE AND, OPTIONALLY, AT LEAST ONE ATTRIBUTE. THE TEMPLATE IS SENT TO THE SERVICE FRAMEWORK, WHICH RECORDS IT IN ITS REMOTE SERVICE EVENT NOTIFICATION REGISTRY. A REGISTRATION OBJECT IS SENT TO THE REQUESTOR
REMOTE LOOKUP SERVICE FRONTEND COMMUNICATING WITH REMOTE LOOKUP BACKEND?
524
NO
525
GO TO BLOCK 542 IN FIG.13
YES
526
SERVICE FRAMEWORK INVOKES THE REMOTE LOOKUP DAEMON
REMOTE LOOKUP DAEMON PERFORMS SEARCH FOR THE REMOTE SERVICE BACKEND BY SEQUENTIALLY INVOKING THE REMOTE LOOKUP SERVICE FRONTENDS, IF ANY (THIS OPERATION COMPRISES THOSE SHOWN IN BLOCKS 562/564/566 OF FIG.14)
528
532
GO TO BLOCK 568 OF FIG,15

FIG. 12

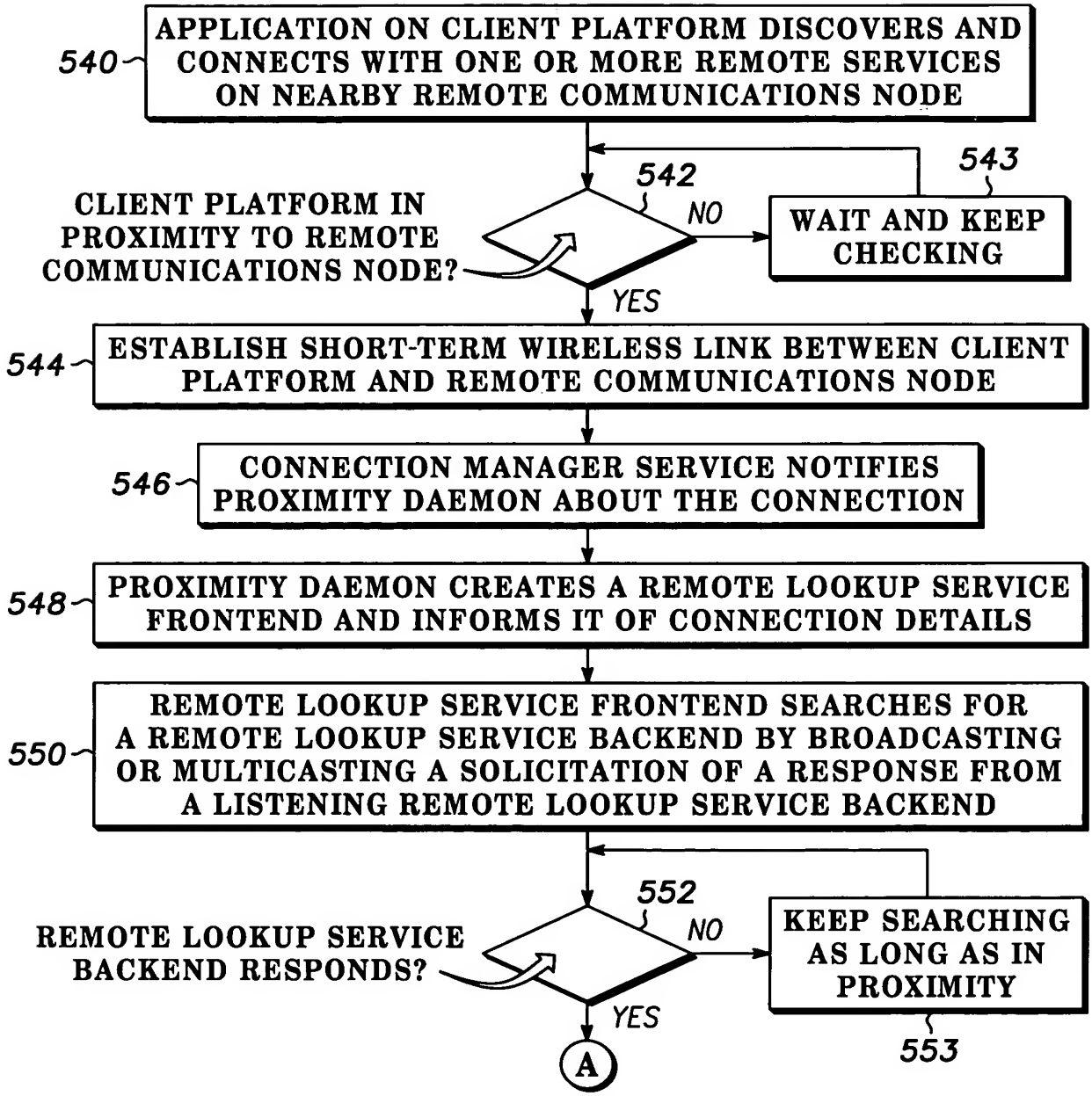
APPLICATION ON CLIENT PLATFORM DISCOVERS AND CONNECTS WITH ONE OR MORE REMOTE SERVICES ON NEARBY REMOTE COMMUNICATIONS NODE
540
542
543
CLIENT PLATFORM IN PROXIMITY TO REMOTE COMMUNICATIONS NODE?
NO
WAIT AND KEEP CHECKING
YES
544
ESTABLISH SHORT-TERM WIRELESS LINK BETWEEN CLIENT PLATFORM AND REMOTE COMMUNICATIONS NODE
546
CONNECTION MANAGER SERVICE NOTIFIES PROXIMITY DAEMON ABOUT THE CONNECTION
548
PROXIMITY DAEMON CREATES A REMOTE LOOKUP SERVICE FRONTEND AND INFORMS IT OF CONNECTION DETAILS
550
REMOTE LOOKUP SERVICE FRONTEND SEARCHES FOR A REMOTE LOOKUP SERVICE BACKEND BY BROADCASTING OR MULTICASTING A SOLICITATION OF A RESPONSE FROM A LISTENING REMOTE LOOKUP SERVICE BACKEND
552
REMOTE LOOKUP SERVICE BACKEND RESPONDS?
NO
KEEP SEARCHING AS LONG AS IN PROXIMITY
553
YES
A

FIG. 13

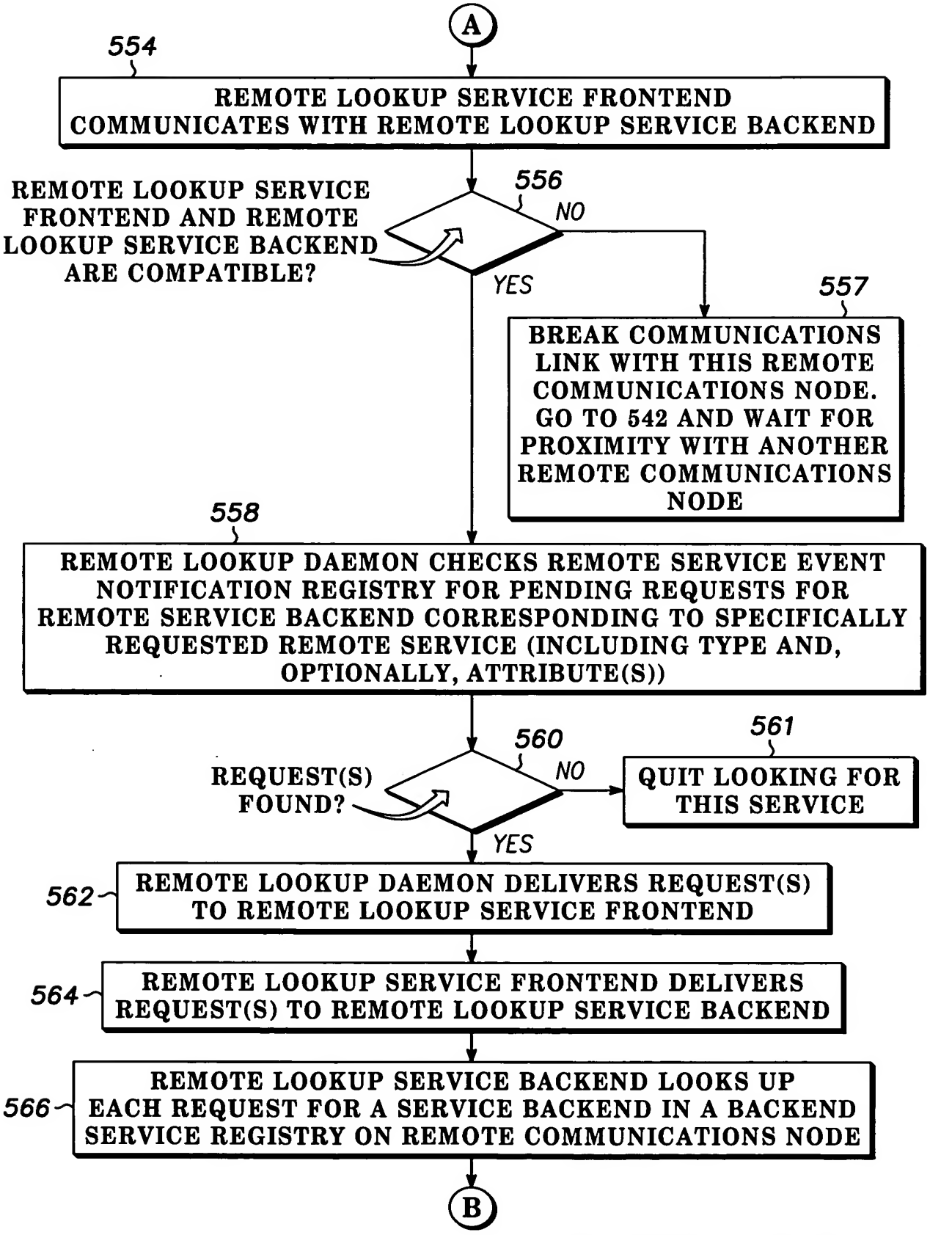
A
554
REMOTE LOOKUP SERVICE FRONTEND COMMUNICATES WITH REMOTE LOOKUP SERVICE BACKEND
REMOTE LOOKUP SERVICE FRONTEND AND REMOTE LOOKUP SERVICE BACKEND ARE COMPATIBLE?
556
NO
YES
557
BREAK COMMUNICATIONS LINK WITH THIS REMOTE COMMUNICATIONS NODE. GO TO 542 AND WAIT FOR PROXIMITY WITH ANOTHER REMOTE COMMUNICATIONS NODE
558
REMOTE LOOKUP DAEMON CHECKS REMOTE SERVICE EVENT NOTIFICATION REGISTRY FOR PENDING REQUESTS FOR REMOTE SERVICE BACKEND CORRESPONDING TO SPECIFICALLY REQUESTED REMOTE SERVICE (INCLUDING TYPE AND, OPTIONALLY, ATTRIBUTE(S))
560
REQUEST(S) FOUND?
NO
561
QUIT LOOKING FOR THIS SERVICE
YES
562
REMOTE LOOKUP DAEMON DELIVERS REQUEST(S) TO REMOTE LOOKUP SERVICE FRONTEND
564
REMOTE LOOKUP SERVICE FRONTEND DELIVERS REQUEST(S) TO REMOTE LOOKUP SERVICE BACKEND
566
REMOTE LOOKUP SERVICE BACKEND LOOKS UP EACH REQUEST FOR A SERVICE BACKEND IN A BACKEND SERVICE REGISTRY ON REMOTE COMMUNICATIONS NODE
B

FIG. 14

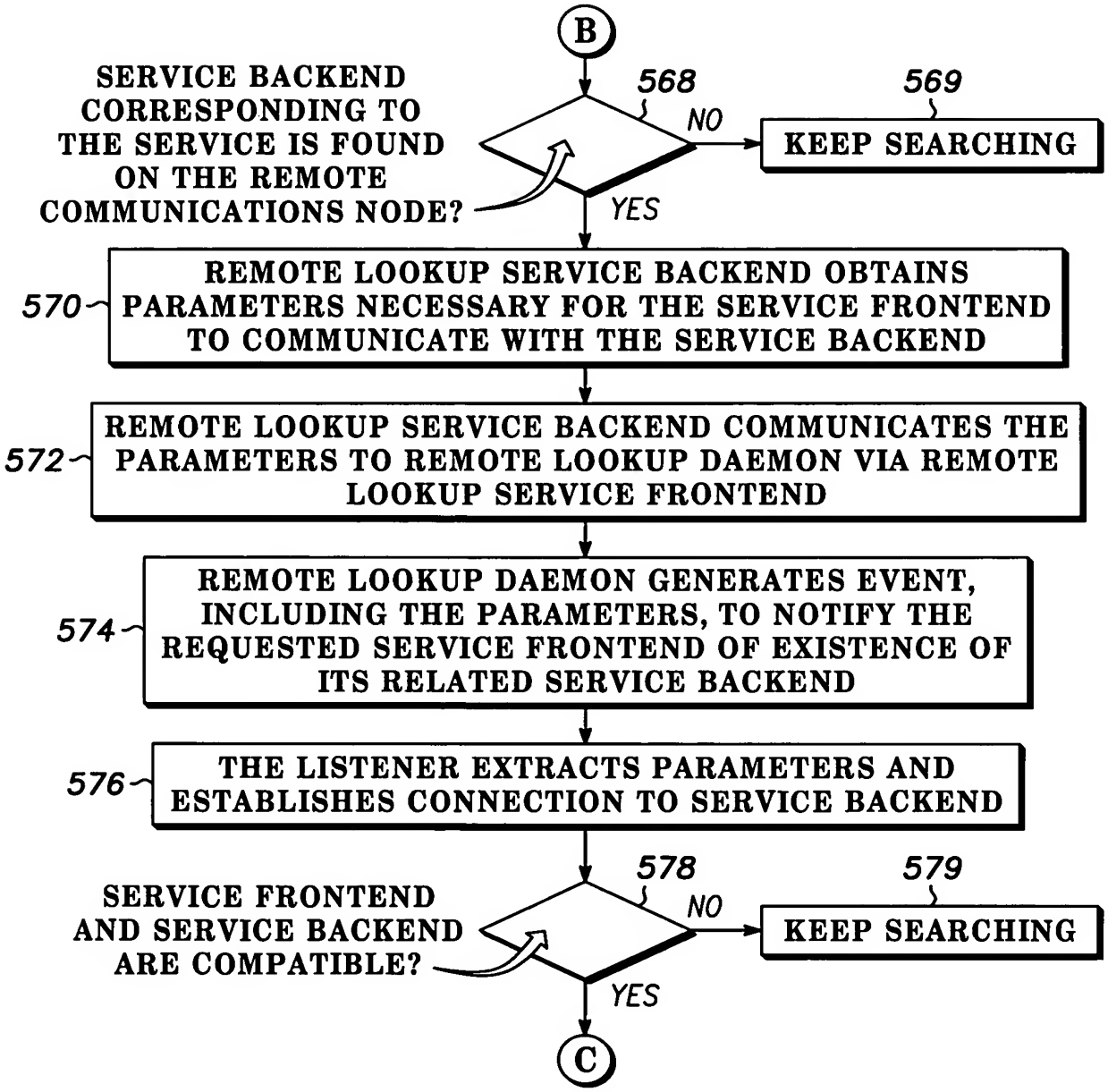
B
SERVICE BACKEND CORRESPONDING TO THE SERVICE IS FOUND ON THE REMOTE COMMUNICATIONS NODE?
568
NO
569
KEEP SEARCHING
YES
570
REMOTE LOOKUP SERVICE BACKEND OBTAINS PARAMETERS NECESSARY FOR THE SERVICE FRONTEND TO COMMUNICATE WITH THE SERVICE BACKEND
572
REMOTE LOOKUP SERVICE BACKEND COMMUNICATES THE PARAMETERS TO REMOTE LOOKUP DAEMON VIA REMOTE LOOKUP SERVICE FRONTEND
574
REMOTE LOOKUP DAEMON GENERATES EVENT, INCLUDING THE PARAMETERS, TO NOTIFY THE REQUESTED SERVICE FRONTEND OF EXISTENCE OF ITS RELATED SERVICE BACKEND
576
THE LISTENER EXTRACTS PARAMETERS AND ESTABLISHES CONNECTION TO SERVICE BACKEND
578
SERVICE FRONTEND AND SERVICE BACKEND ARE COMPATIBLE?
NO
579
KEEP SEARCHING
YES
C

FIG. 15

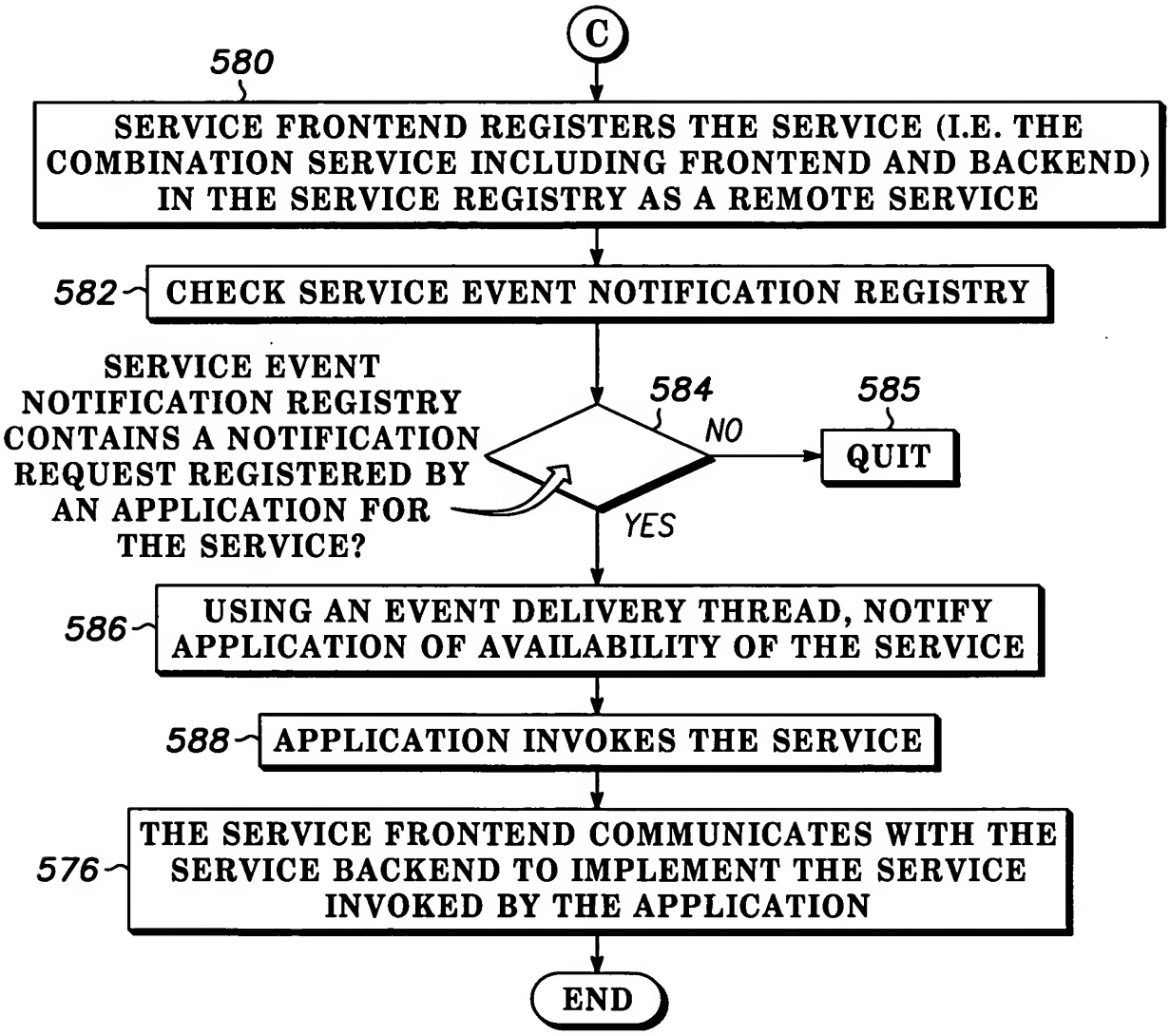
C
580
SERVICE FRONTEND REGISTERS THE SERVICE (I.E. THE COMBINATION SERVICE INCLUDING FRONTEND AND BACKEND) IN THE SERVICE REGISTRY AS A REMOTE SERVICE
582
CHECK SERVICE EVENT NOTIFICATION REGISTRY
SERVICE EVENT NOTIFICATION REGISTRY CONTAINS A NOTIFICATION REQUEST REGISTERED BY AN APPLICATION FOR THE SERVICE?
584
NO
585
QUIT
YES
586
USING AN EVENT DELIVERY THREAD, NOTIFY APPLICATION OF AVAILABILITY OF THE SERVICE
588
APPLICATION INVOKES THE SERVICE
576
THE SERVICE FRONTEND COMMUNICATES WITH THE SERVICE BACKEND TO IMPLEMENT THE SERVICE INVOKED BY THE APPLICATION
END

FIG. 16

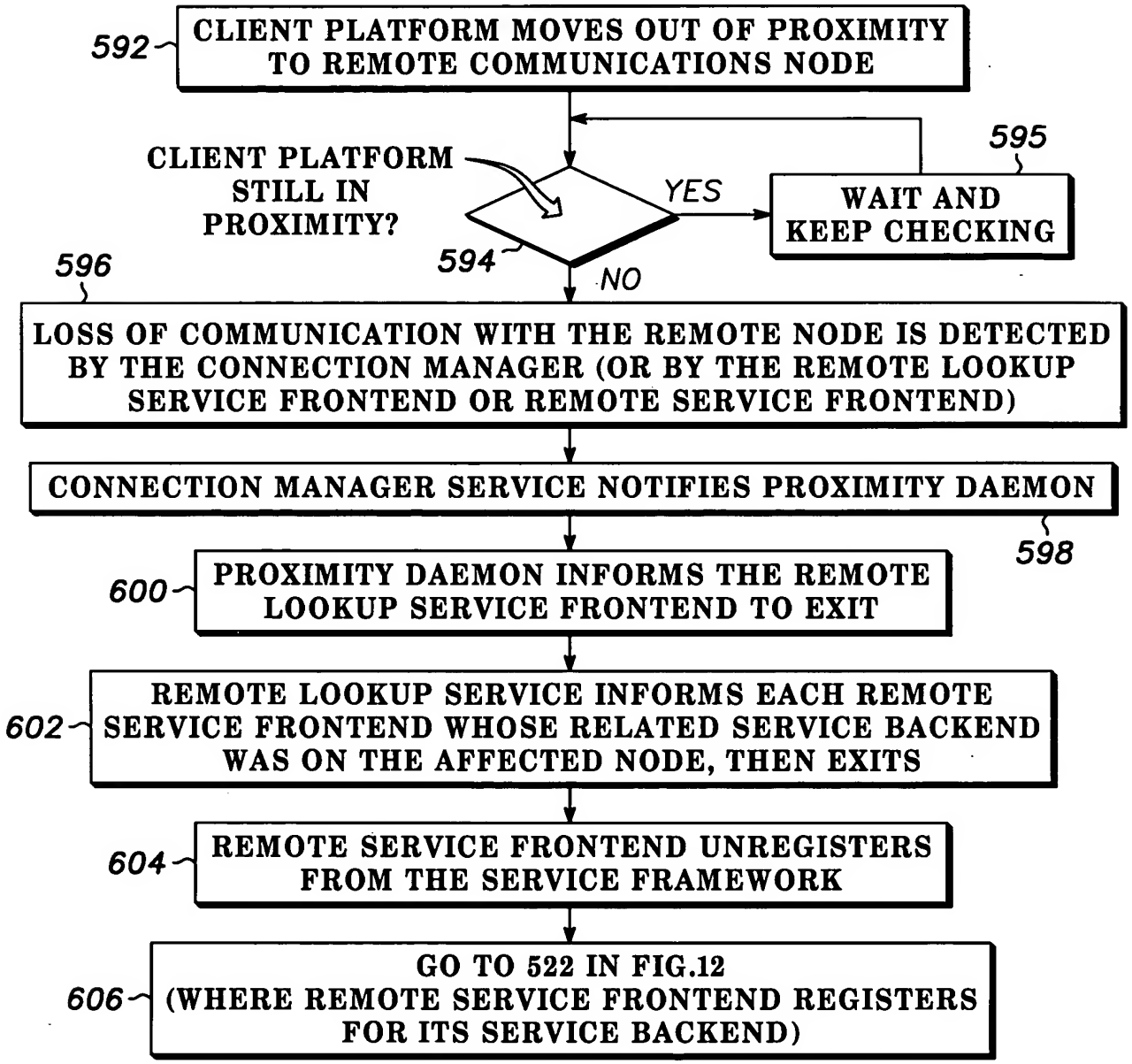
592
CLIENT PLATFORM MOVES OUT OF PROXIMITY TO REMOTE COMMUNICATIONS NODE
CLIENT PLATFORM STILL IN PROXIMITY?
YES
595
WAIT AND KEEP CHECKING
594
NO
596
LOSS OF COMMUNICATION WITH THE REMOTE NODE IS DETECTED BY THE CONNECTION MANAGER (OR BY THE REMOTE LOOKUP SERVICE FRONTEND OR REMOTE SERVICE FRONTEND)
CONNECTION MANAGER SERVICE NOTIFIES PROXIMITY DAEMON
598
600
PROXIMITY DAEMON INFORMS THE REMOTE LOOKUP SERVICE FRONTEND TO EXIT
602
REMOTE LOOKUP SERVICE INFORMS EACH REMOTE SERVICE FRONTEND WHOSE RELATED SERVICE BACKEND WAS ON THE AFFECTED NODE, THEN EXITS
604
REMOTE SERVICE FRONTEND UNREGISTERS FROM THE SERVICE FRAMEWORK
606
GO TO 522 IN FIG.12
(WHERE REMOTE SERVICE FRONTEND REGISTERS FOR ITS SERVICE BACKEND)

FIG. 17